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RESOLUTION OF LOW-FREQUENCY ATTENUATION ANOMALIES IN THE SOUTHERN HEMISPHERE

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During Project Kiwi One (D. G. Browning et al., Nature, 282, 820-822 (1979)) anomalously high values of low-frequency attenuation were observed in the central South Pacific Ocean. Similar results were obtained along a track from New Zealand into the Southern Ocean during Project Tasman Two (R. W. Bannister et al., J. Acoust. Soc. Am., 62, 847-859 (1977)). A recent analysis of oceanographic data by Mellen shows that both regions are included in a relatively high pH contour at the sound channel axis. The corresponding predicted values of attenuation are in reasonable agreement with the measured data.

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Resolution of Low-Frequency Attenuation Anomalies in the Southern Hemisphere

A Paper Presented at the 113th Meeting of the Acoustical Society of America, 11-15 May 1987, Indianapolis, Indiana

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PREFACE

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RESOLUTION OF LOW FREQUENCY ATTENUATION ANOMALIES IN THE SOUTHERN HEMISPHERE

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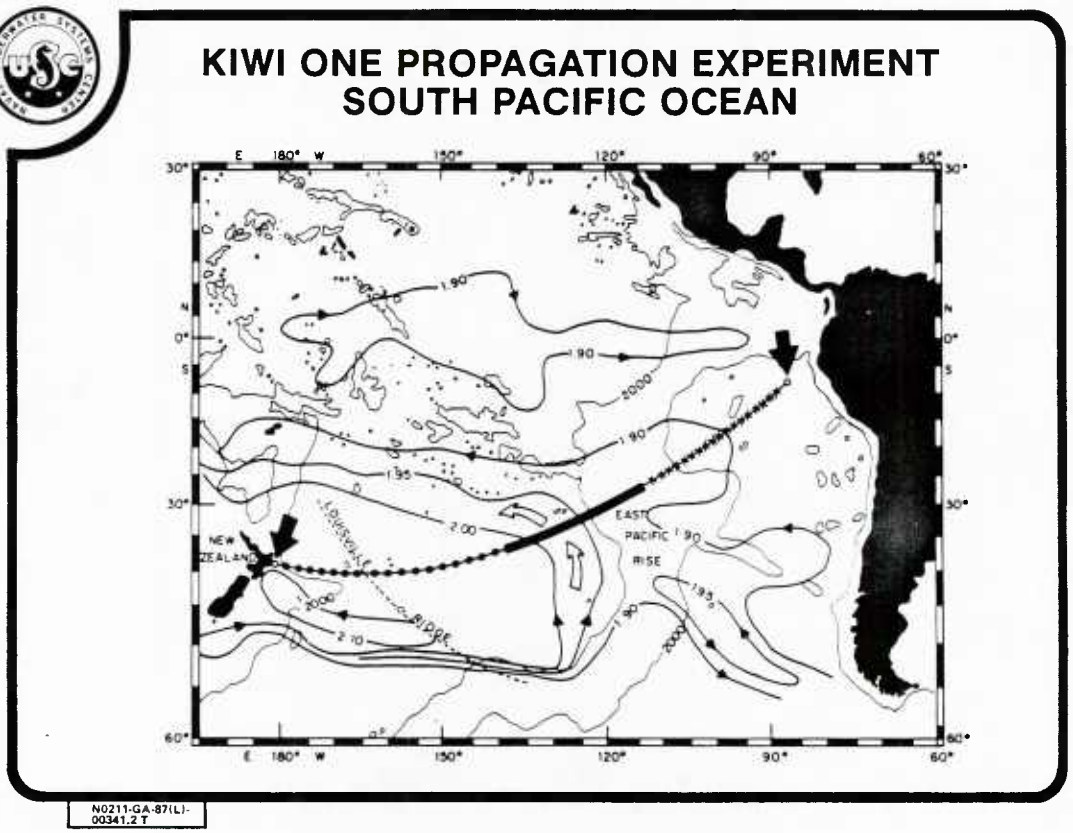
N0211-GA-87(L)-00341.1 T

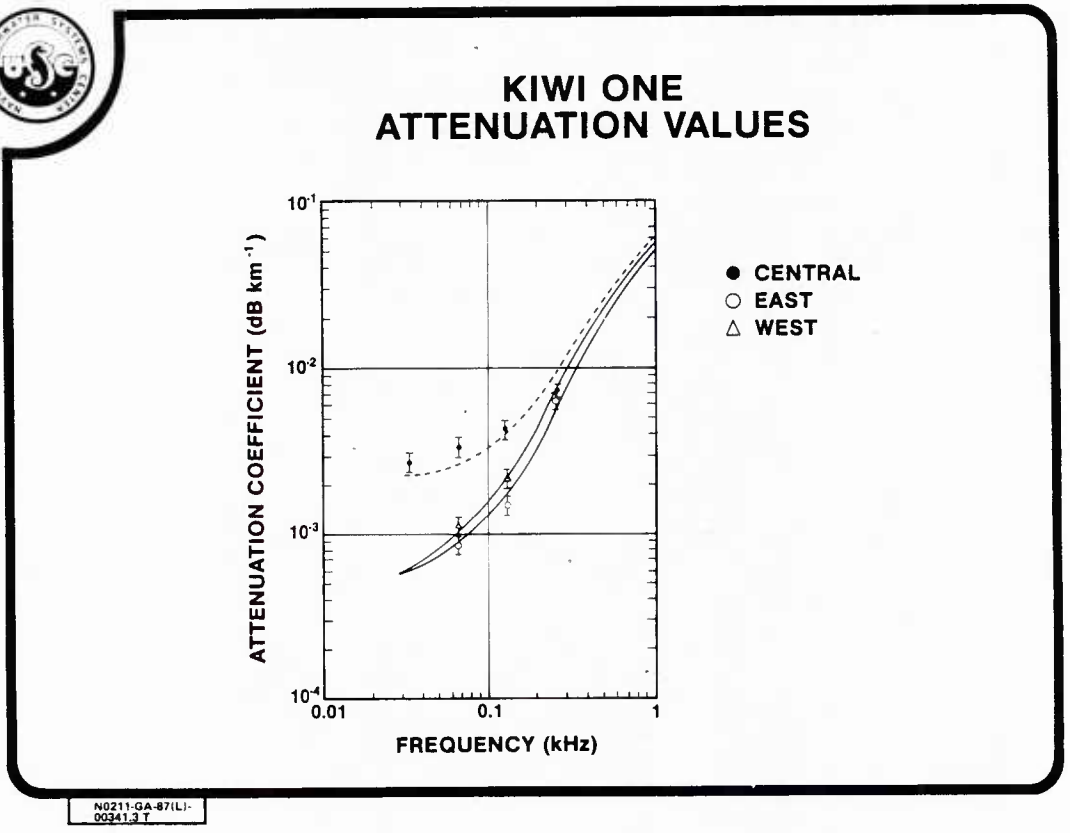
VIEWGRAPH 1

There are several areas of the South Pacific Ocean and adjacent Southern Ocean where the absorption component of low frequency attenuation appeared to be higher than predicted. An analysis of pH profiles in the southern hemisphere has resolved this dilemma. These results will be reported in this paper.



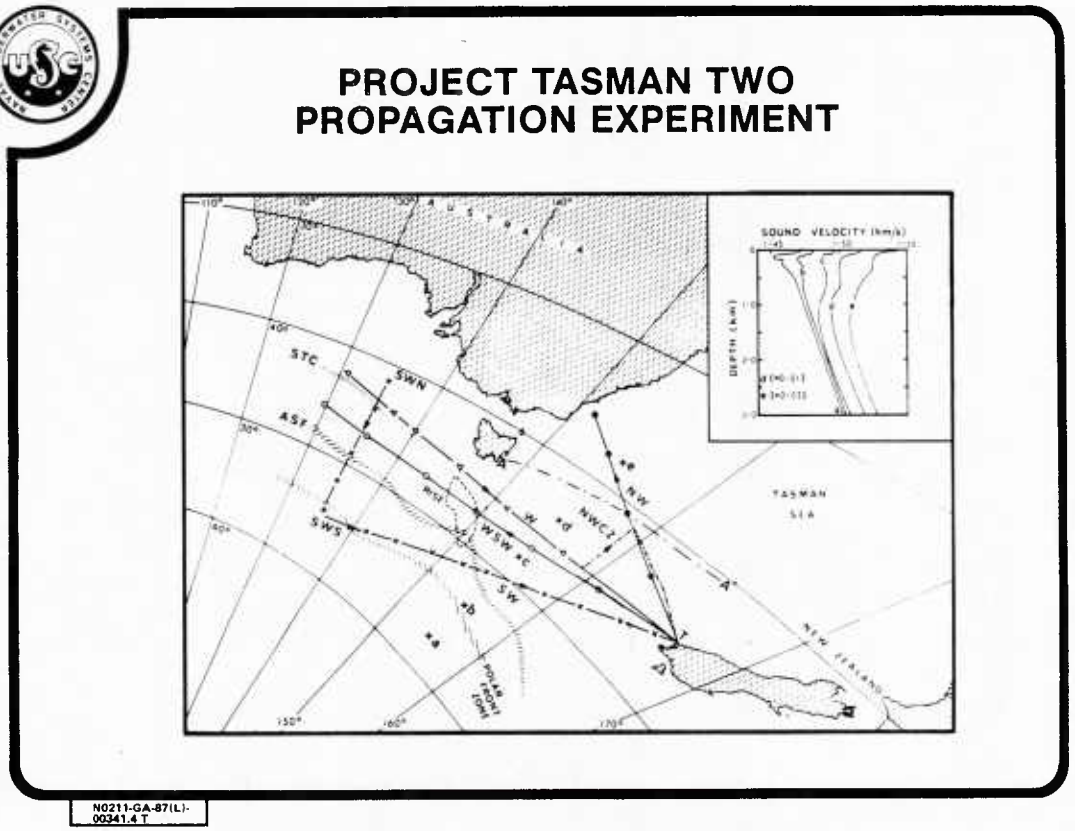
VIEWGRAPH 2

In the 1970's we conducted what we hoped would be the definitive attenuation experiment in the South Pacific Ocean: Project Kiwi One. The uniformity of the sound channel axis depth across the vast ocean allowed an extremely long data base of 10,000 km. We found, however, that the measured attenuation was not uniform but divided into three distinct regions which we termed west, central, and east.



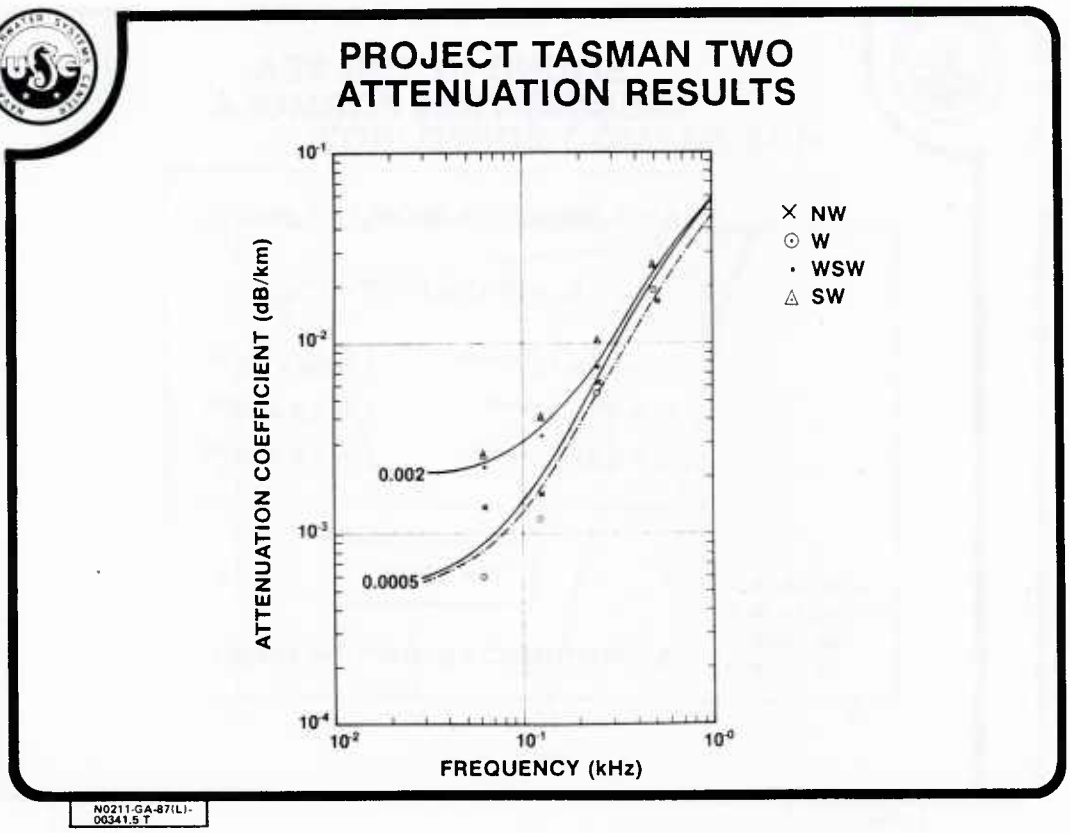
VIEWGRAPH 3

The attenuation in the east and west regions was pretty much as expected. Data from the central region was significantly higher. It appeared related to the strong influx of intermediate water from the south but at the time we just had no good explanation.



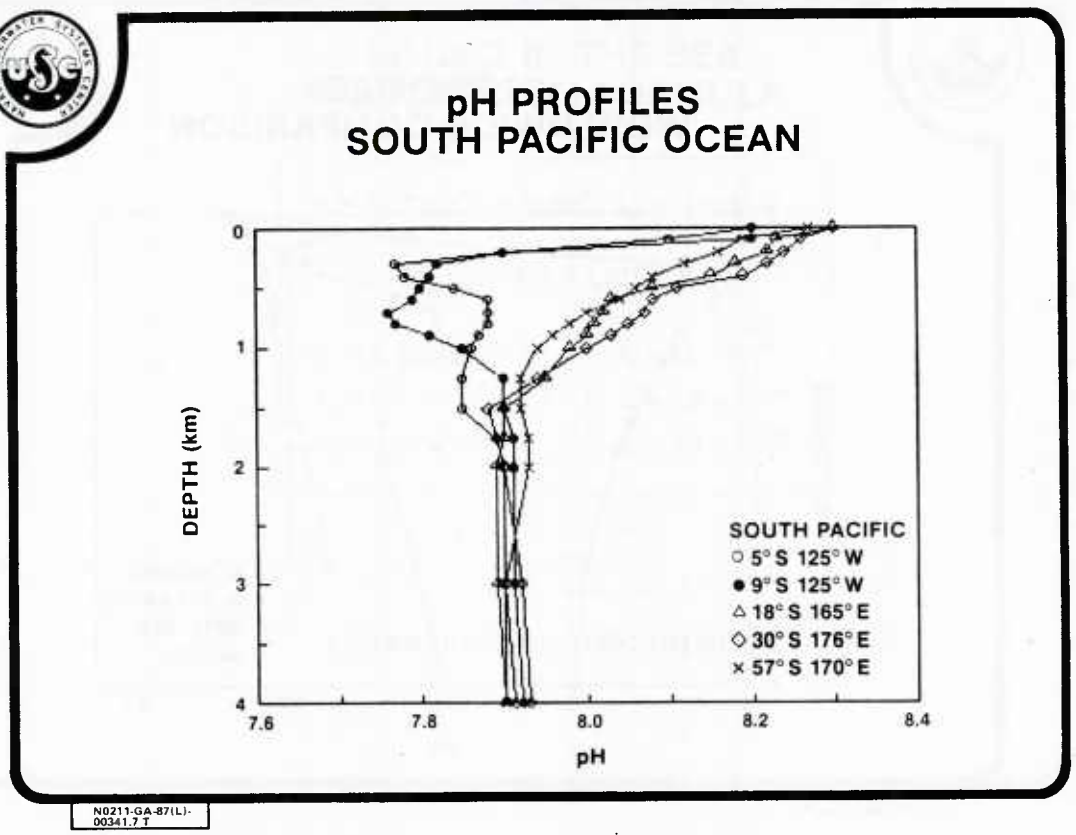
VIEWGRAPH 4

Many of the southern hemisphere water masses run parallel to the dominant Antarctic circumpolar current. In the late 1970's we ran a series of acoustic tracks from the southern tip of New Zealand. These were designed to lay in and/or cross specific water masses. Only the southernmost track, designated as SW, produced anomalous results.



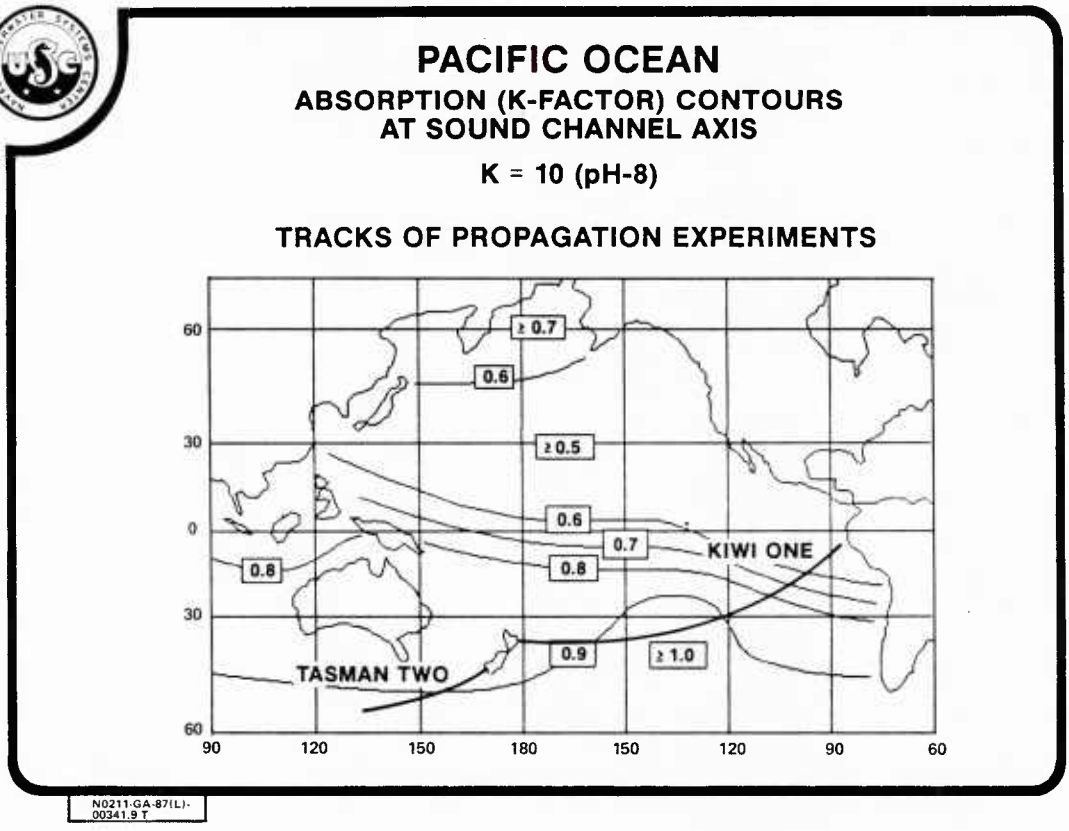
VIEWGRAPH 5

These anomalously high values of attenuation observed along the SW track were very similar to those measured in the central region of the Kiwi One track. It was not obvious, however, what the Southern Ocean and the central South Pacific had in common.



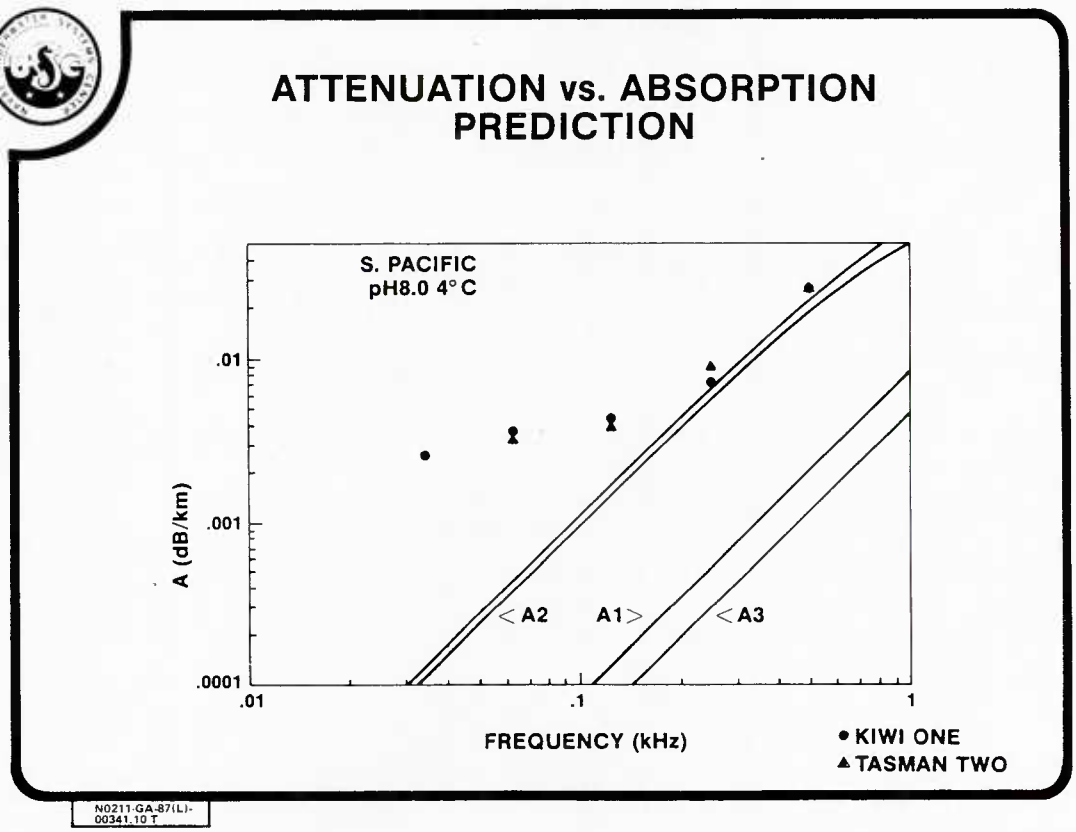
VIEWGRAPH 8

For the South Pacific, typical pH profiles show the influence of the relatively low pH North Pacific down to 10° south latitude, then the influence of the Antarctic circulation is felt and the profiles become more uniform. However, if the sound channel axis becomes shallower at higher latitudes, the attenuation for SOFAR propagation becomes greater even though the pH profile hasn't, because we have moved up the curve to higher pH values.



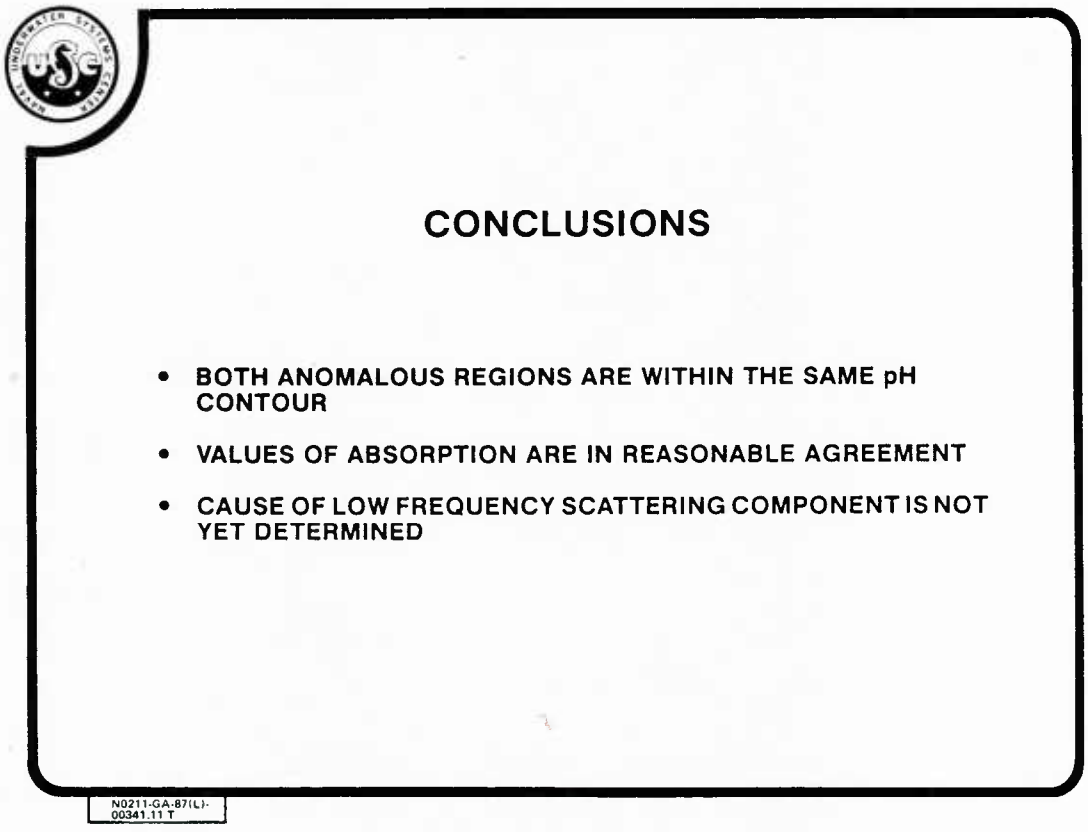
VIEWGRAPH 9

If we plot absorption (k–factor) contours for the Pacific Ocean based on a recent analysis by Bob Mellen, we can see both the cause of the anomaly and the reason for the similarity of the Kiwi One and Tasman Two results. The highest absorption contour encompasses the central region of the Kiwi One track and the SW track of Tasman Two.



VIEWGRAPH 10

For frequencies of 200 Hz and above the data from both regions blend in well with the predicted absorption values. Below 200 Hz the attenuation levels off as a mechanism other than absorption begins to dominate. We believe this is due to scattering but no one has conclusively proved this yet.



VIEWGRAPH 11

In summary:

- o Both regions of high attenuation fall within the same pH contour.
- o Above 200 Hz the data are in good agreement with the predicted absorption.
- o We believe we can now accurately predict absorption for any ocean, however, the frequency independent attenuation below 200 Hz is not yet fully defined or understood.

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